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# RELAY INTERCROPPING WHEAT AND SOYBEAN

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## Introduction

Relay intercropping is defined as growing two or more crops simultaneously during part of the life cycle of each (Andrews and Kassam, 1976). That is contrasted to the practice of sole cropping where most midwest farmers plant one crop per field per season. In other words, corn is planted in May and harvested in October.

Why would farmers be interested in trying relay intercropping when they are already acquainted and efficient in sole cropping systems? The answer is the potential to increase total production per unit area of land during one cropping season and the potential to conserve soil from wind and water erosion during the winter and spring months each year (Chan et al., 1980).

How does the relay intercropping system work? First, the farmer would plant winter wheat in September, the normal time for planting winter wheat. The winter wheat will normally head in mid-May and mature in early July. Soybean would be interseeded between the rows of wheat at the normal soybean planting time of early May, just prior to heading of the wheat. Soybean and wheat will compete from May until July. After wheat harvest the soybean will not have further competition until harvest in October.

## Crop Selection

Farmers must take into account several considerations which will affect the success of relay intercropping. Small grain cereal crop selection may be made from wheat, oat, barley, rye, triticale, or possibly others. The key is to select a crop which has a market infrastructure developed in the region and one with which the farmers have some knowledge of management practices. It is extremely important to plant the winter annual crop. Planting of a spring crop depends on spring weather which is very irregular, the winter planted small grain cereals will mature earlier in the summer than spring planted types of the same crop. Early maturing varieties are preferred providing the variety has good yield potential (Jeffers et al., 1977). The farmer should not sacrifice yield potential for early maturity.



## **Row Spacing**

Row spacing of both the small grain crop and soybean are important for the success of the relay intercropping system. Wide wheat rows being greater than 10 inches in spacing will benefit the soybean but may result in reduced wheat yield. Wide soybean rows will reduce the mechanical damage caused to the wheat during planting of the soybean, but wide row soybean may also reduce soybean yield potential.

## **Variety Selection**

Care must be taken in soybean variety selection also. Three soybean growth types are available. The determinate types are traditionally grown in the southern United States, but a few varieties have been developed in the northern U.S. The indeterminate varieties are most commonly used throughout the upper midwest and tend to be taller in growth habit than the determinate types. There are also semi-determinate types that are intermediate in plant height. The determinate soybean varieties are less likely to overcome early stress created by the competition with wheat or other winter cereals (Chan et al., 1980). The indeterminate soybean types will continue vegetative growth after wheat harvest, providing an opportunity for more photosynthetic activity and yield potential from the indeterminate soybean growth types. A full season high-yielding soybean variety is imperative if the farmer expects success of this system (Jeffers et al., 1977).

## **Planting Equipment**

Soybean planting equipment is also critical to reduce the damage caused during the soybean planting process on the wheat plants. Less damage occurs if the soybean are planted before the wheat heads emerge. Extreme care must be taken when interseeding soybean between wheat rows in order to maintain equidistant spacing between the wheat rows and reduce the amount of mechanical damage to those wheat rows by the soybean planting machine. Less mechanical damage occurs to the wheat when the soybean rows are planted at wider distances, thereby reducing the possibility of mechanical damage on all rows. Reports from Missouri and Kansas have indicated that as much as 15% yield loss occurs to the wheat due to mechanical damage (Reinbott et al., 1987, and Duncan et al., 1990).

## **Date of Planting**

The date of planting of soybean is also critical to the success of this system. If soybean are planted too early, they will grow tall enough that the tops of the soybean plants will be clipped off during the wheat harvest process (Brown, 1982). This does not necessarily kill the plant but it may stress the soybean plant and reduce the yield potential (Whigham, 1985). If the soybean are planted late, after the wheat is headed, studies have shown that the yield potential is less because the growing season is shorter (Reinbott et al., 1987).



## Weed Control

Weed control for the wheat prior to soybean planting is routine for wheat management and weed control for soybean after the wheat has been harvested is routine for soybean management. However, special care must be taken to control weeds when both wheat and soybean are companion crops (Moomaw and Powell, 1990). The period from mid-May until early July is when most common weeds require control in Iowa. Care must be taken to select a herbicide that is compatible to both wheat and soybean. This may be difficult because these crops belong to different families, soybean is a legume broadleaf and wheat is a grass plant.

## Weather Considerations

Weather must also be considered for relay intercropping systems of wheat and soybean. Drought stress during the soybean seedling stage may reduce the stand establishment due to the severe competition from the already established wheat plants. An extensive wheat root system has been developed during the season from planting wheat in September until planting soybean in May. No-till planting of soybean is essential and the young soybean seedling has difficulty competing with the established wheat plants for moisture, light and nutrients. If moisture is limiting due to a drought in May and June, the resulting stand establishment from soybean is likely to be poor. The closer the row spacing of the wheat plants to the newly planted soybean seeds, the greater the problem will likely be.

During the winter months the lack of a snow cover to protect the wheat seedlings may also result in wheat stand reduction due to ice and heaving that will eventually result in reduced wheat yield potential. A wet May will reduce the probability of timely soybean planting and may also reduce wheat maturity. The success of this system depends on early harvesting of the winter cereal crop so the soybean crop can utilize the entire field environment for a longer growing season.

## Land Equivalent Ratio

In order to measure the agronomic efficiency of relay intercropping the land equivalent ratio formula has been developed. This is not an economic evaluation, but an agronomic evaluation. The description of land equivalent ratio is the ratio of the area needed under sole cropping to one of intercropping at the same management level to give an equal amount of yield (Andrews and Kassam, 1976). The ratio is determined by calculating the ratio for each crop as follows:

$$\text{L.E.R.} = \frac{I_w}{S_w} + \frac{I_s}{S_s}$$

S = sole yield

I = intercrop yield

w = wheat

s = soybean

If the ratio is greater than 1.0 totaled between the two crops, there is an advantage to the relay intercropping system compared to sole cropping as far as agronomic efficiency for the crops involved. If the land equivalent ratio is less than 1, the advantage lies with sole cropping.

### Summary

In summary, relay intercropping is a form of intense management with the potential to increase total production per unit area of land in a calendar year. Timely management is essential to experience success with relay intercropping. Adequate rainfall, especially during the companion period of time between the two crops, is essential for success of the relay intercropping system so moisture stress does not limit the stand establishment of the later planted crop. The selection of an optimum management system that will not reduce yield potential of one crop in order to promote the yield potential of the other crop will be optimum for this system, and more efficient use of land can be accomplished with a relay intercropping system.

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